

ON THE PROBABLE ORIGIN, DEVELOPMENT AND
DIFFUSION OF NORTH AMERICAN SPECIES
OF THE GENUS *DIABROTICA*.*

By F. M. WEBSTER.

This genus of Coleoptera is almost exclusively confined to the western hemisphere, with its native habitat, seemingly, in the Neotropical Region. In fact South America would appear to have been its original home, from which country the eighteen species known to inhabit North America north of Mexico might almost be supposed to have originally sprung, while one of these species, *balteata*, appears to have unchanged, spanned the borderland, so to speak, being found from Texas southward to Colombia, South America. The species of this genus number something like four hundred, which fact, when compared with the limited number occurring in our own fauna, would of itself suggest that we were on the extreme outskirts of its northern habitat. With this idea of the northern spread from the tropical habitat in mind, we can readily comprehend the evolution of the two species, *12-punctata* and *soror*, the former ranging over the eastern region from Canada to southern California and possibly into Mexico, while the latter ranges from Oregon southward, also into Mexico, and covering Arizona. It is as if from out of the Lower Sonoran of Mexico twin species had been evolved, the one, *soror*, making its way to the west of the great mountain range, while the other, *12-punctata*, spread over the country to the north and northeastward. It is true these two species occupy the same area in Arizona and southern California, but I believe that a careful study of their respective habitats there will show that they do not occupy areas of the same altitude. That *12-punctata* breeds freely in low, alluvial sections there is ample proof. I have found their larvæ in destructive abundance in districts along the Mississippi River where the land was subject to overflow, and Prof. Forbes (18th Report State Entomologist of Illinois, p. 157, foot-note) finds larvæ, supposed to belong to this species, destructively abundant in a field in southern Illinois that had been under water for nearly three weeks in spring. In an earlier publication (*Entomologica Americana*, II, p. 174) this was thought to be the larvæ of *longicornis*, but afterwards referred to *12-punctata*, because

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the former species was not known to be destructively abundant in that portion of Illinois. I have ample proof that *longicornis* breeds in destructive abundance in bottom lands along the Wabash River in Indiana, which lands are subject to overflow annually, sometimes as late as May or even June, thus indicating that both of these species may breed freely in very low lands. Unfortunately, the earlier stages and habits of the larvæ of *soror* are unknown, and we cannot say whether it breeds in high or low lands, nor can I say whether or not it prefers the higher elevations of cultivated areas.

In the species *vittata* and *trivittata* we have the same phenomena as to distribution, the latter species occurring throughout California and possibly southward, while the former ranges over the whole eastern portion of the United States and into Canada, to the north, while it extends southward into Mexico, where we shall probably find that both species cover the same area, though probably at different elevations. In New Mexico, Prof. Cockerell has found a form intermediate between these species and occurring between the regions occupied by them, which he has called *incerta*, and which extends also southward into Mexico. *D. tricineta*, which occurs from Central America northward to Colorado, might almost be said to occupy the same relation towards *D. 12-punctata* and *soror*, though Prof. Wickham found both at Albuquerque, New Mexico, and Prof. Snow took both at Socorro, N. M., the elevation of both localities being 5,000 feet. Prof. Cockerell writes me that he finds *D. 12-punctata* rarely at Santa Fé, elevation 7,000 feet, while it is abundant in the Mesilla Valley, elevation 3,800 feet; *tricineta* being rare. It certainly looks as though there was somewhere in Mexico or Central America a veritable nursery for species, and where the evolutionist might revel in a scientific paradise. I cannot help feeling that within the borders of Central America and Mexico we may sooner or later discover the key that shall solve the mystery of the origin of many of our species of *Diabrotica*.

To me *longicornis* is above all others the most interesting of the *Diabrotica*, not because of its economic importance, but on account of its extended range and peculiar distribution. Occurring, as it does, from Yucatan northward through Mexico, New Mexico to Colorado, Kansas, Nebraska and Iowa, it sweeps to the northeast through Illinois, Indiana and western Ohio, while it is known to occur abundantly about Buffalo, N. Y., where it has been collected by Mr. Reinecke, and also at Aulac, New Brunswick, by Mr. W. Hague Harrington. With the possible exception of the Boreal, it thus inhabits every Life Zone on

the continent of North America. This species appears to prefer the lower altitudes, as it has not been found above the 5,000-foot level, and over the area of its greatest abundance in the Mississippi valley the elevation is generally less than 2,000 feet, and in Illinois, Indiana and Ohio it is less than 1,000 as a rule. I have previously shown that it can breed freely in low and damp localities, and Mr. Harrington found it in New Brunswick abundantly in the "dyked lands" known as the Big Tantramah Marsh. The rapidity with which this has increased in numbers, in some portions of the country, during quite recent years, is simply astonishing. Where I could scarcely get specimens enough for a series in my collection, twenty years ago, it is now one of the most injurious insects known to the farmer, and this, too, at an elevation of not over 900 feet. Over the western third of Ohio, across Indiana and Illinois to the Mississippi River, through Iowa, eastern Kansas and eastern Nebraska, is largely a prairie country, and such a part of this area as was in cultivation up to 1860 was devoted mainly to wheat growing. From about 1865 onward farmers ceased to raise wheat as a leading crop, and corn became king of the cereals. Sometime between 1865 and 1875 this species of *Diabrotica* seems to have been attracted to the immense corn fields by the inexhaustible supply of food they afforded for the adults, and as later investigations have shown, for the larvæ also, and these immense stretches of corn lands soon became breeding grounds for vast myriads of the insect. So far as we now can see, the centre of this outbreak, if such it might be called, was in central or northern central Illinois, and it is here that appears to have evolved a race not differing specifically or perceivably, yet whose larvæ develop on the roots of Indian corn, while the adults may subsist alike on the silk and pollen of the corn, the bloom of Solidago, thistle and clover, and the result has been that not only has the species increased enormously in point of numbers and far above what could ordinarily exist in the natural flora, but there seems to have been a sort of overflow of this race, precisely as though a slow but constantly moving wave had spread out over the west, north and east; these directions being governed by the area continually planted with corn. In Ohio this problem offers a fine illustration of the effect of cultivated plants on the spread of insects. The area over which the species occurs, even rarely as my observations of the last four years have shown, is continually being extended to the eastward, it having been found abundantly this year where the most careful search failed to reveal it last year or the year before last. In Ohio more or less of the inland streams flow more or less

directly northward or southward, and the valleys of these streams are largely devoted to corn growing, the land being continually planted year after year, in some places since the beginning of the present century. This species appears to gain access to these valleys from the west, and we find that one after another is being overrun in the eastward march of the species. First it appeared in the valleys of the Little and Big Miami Rivers, then the Upper Wabash and Maumee, and this year it occurs throughout the entire length of the Scioto River and the upper portion of the Sandusky River, thus nearly covering the western third of the State.

The distribution of *D. atripennis* and its varieties is given by Dr. Horn (Trans. Am. Ent. Soc. Vol. XX, p. 95) as extending from Massachusetts* to Dakota, Kansas and Texas. It does not appear in the lists of Coleoptera collected about Buffalo, N. Y., by Reinecke and Zesch, or about Cincinnati, Ohio, by Dury, about Detroit, Mich., by Hubbard and Schwarz, or at Iowa City, by H. F. Wickham. Years ago, when I was engaged in exchanging Coleoptera, this appeared to be one of the species most desired among collectors, though I never failed to find the var. *fossata* in abundance during August and September, in northern Illinois, at an elevation of little more than 800 feet. Prof. Cockerell records it from Gallinas Cañon, New Mexico, at an elevation of 7,000 feet.

Except *vineta*, which is an extreme Southeastern species, all of our Diabroticas appear to have originated in the extreme Southwest, Mexico and Central America, at least such as we cannot trace directly to South America. The Rocky Mountains appear to have formed a divide in the current and sent two species to the west coast, while to the east of these mountains, *vittata*, *12-punctata* excepted, all appear to have worked their way northward along the eastern base of this range, until reaching Colorado and Kansas, when they have swept broadly to the northeast, precisely as has *longicornis*, which Say discovered in 1824, near the base of the Rocky Mountains.

Prof. Cockerell has sent me the following list of *Diabrotica*, found in the West Indies, all being from Cuba. *D. annulata*, *cyanoaspila*, *impressa*, *loricata*, *relicta* and *semicyanea*. *D. amannula* and *D. octonotata* are from Pacific islands, and *D. limbata* from the Galapagos group. This may be a good place to call attention to the fact that Jacoby's list of the phytophagous coleoptera of Japan, gives a single

*Specimens collected about Lowell, by Mr. Frederick Blanchard, are much lighter in color than are western specimens.

species, and that, *D. rufotestacea* Motsch., as doubtful as to the genus. Curiously enough, *D. 14-notata* has been described from Madagascar, which, if the genus proves correct, will go to substantiate the statement of Dr. A. R. Wallace, that the fauna of this island is more closely allied to that of South America than to South Africa, to which it lies almost contiguous.

With respect to the food of the species of *Diabrotica*, I have no data except as to species of our fauna. The name means one that gnaws through, and we usually consider them leaf eaters, and, while this is true to some extent, yet they are really pollen eaters and prefer the bloom to the foliage. We know how destructive *12-punctata* and *vittata* are to the young Cucurbs, but as soon as the blossoms appear they largely forsake the leaves and frequent only the flowers, the former I have observed in the woods in October, feeding on the belated bloom of *Aster sagittifolius*, after the Cucurbs had been killed by frost; the adults are probably no more leaf eaters, in general, than they are fruit eaters. I have myself found *vittata*, *12-punctata* and *longicornis* feeding upon ripe apples, melons, squashes and pumpkins, and, too, have observed them all feeding upon the silk and pollen of corn. All three of them are found on the Golden Rod (*Solidago*), Wild Sunflower (*Helianthus*), and I always captured *atripennis* var. *fossata* on the bloom of the Compass Plant (*Silphium*), and the fondness of *longicornis* for the blossoms of thistle has long been observed as a marked characteristic, and we know that they forsake the cornfields as soon as the supply of pollen fails and the silk turns to brown. Mr. Charles Robertson, in his admirable series of papers in the Botanical Gazette on "Flowers and Insects," gives the following as frequented by *12-punctata*: *Nelumbo lutea*, *Impatiens fulva*, *Ceanothus americanus*, *Amorpha canescens*, *Enothera fruticosa*. Forbes, 18th Report State Entomologist of Illinois, gives also the blossoms of roses, dahlias and cosmos; while I have observed it to swarm on the flowers of *Senecio* or Groundsel, in Louisiana, in early spring. It also attacks the foliage of the following plants: Horse nettle, cabbage, cauliflower and beans, while of trees they are known to eat the leaves of plum, cherry, apricots and also the raspberry. I have found both this *vittata* and *longicornis* feeding upon the unripe kernels of corn, while *12-punctata* was found similarly engaged on unripe wheat. Besides thistle blossoms, *longicornis* has been recorded by Prof. Forbes as feeding on the pollen of smartweed, ragweed, clover and *Helianthus*. Of the food plants of *soror*, I know nothing from personal observation, but Coquillett reports both this and *trivittata* as

frequenting the blossoms of *Yucca whipplei*, while Koebele states that it is destructively abundant on many fruits and vegetables and that he has observed it feeding upon the leaves of young corn, the larvæ having been found by him attacking the roots. From all of the foregoing it will be seen that while the members of this genus in our country feed upon both fruit and foliage, it is the bloom to which they pay particular attention as soon as it is accessible to them. Still, it must be admitted that while *longicornis* has a fondness for the bloom of the cotton plant, yet it can hardly be said to occur in the cotton-growing portion of the country, and I can only suggest that it is primarily a grass insect, feeding in the larval stage upon the roots, and, largely at least, in the adult state on the blossoms of various flowers. Both Schwarz and Luger have found pupæ of *12-punctata* about the roots of *Rudbeckia*, and Marten found the larvæ among the roots of *Cyperus strigosus* and *Scirpus fluviatellus*, while I have taken the supposed larva of this species feeding on young wheat plants below ground. We only know that the larvæ of *vittata* has been found in the roots of Cucurbs, which does not necessarily imply that it too may not breed among the roots of grass or plants of a kindred nature. The two species, *vittata* and *12-punctata*, appeared to have occupied the country to the east of the Rocky Mountains from an early day, as we hear of their depredations from the earliest settlement of the country, and we may fairly assume that both may have spread over the country from the southwest, supporting themselves in both the larval and adult stages upon the indigenous vegetation, though we can, of course, not say that the cultivated fields of both the Aztecs of Mexico and our own aborigines have not aided in their diffusion. Much less do we know or shall we be able to learn the influence that might have been offered by that extinct race of men, now only known by their stupendous earthworks that are scattered over the country, but of whose daily lives we know absolutely nothing, and therefore cannot measure their influence on the flora and fauna of their time. All facts now in our possession indicate that *longicornis* has spread eastward at a comparatively recent time, and though we only know of one food plant, corn, it is almost certain that there are others. Mr. Reinecke writes me that he collects all of his specimens of the beetle from willows growing near a small stream, not far from Buffalo, while Mr. Harrington calls attention to the lack of corn in the vicinity of where he found these beetles in New Brunswick, and states that the species must breed in the roots of some of the larger grasses. So far as known then, with the possible exception of *vittata*, the species shows a tendency toward the grasses as food plants for the larvæ.

The fact that several species of this genus are literally swarming over large areas of country, and their habits are such as to expose them almost continually during the adult stage to attacks of birds, while in all of the investigations of the food of birds they rarely appear, has raised the question of their being inedible. The colors of our commonest species are black, black and yellow, and green. It is true that a majority of the blossoms frequented by these beetles are more or less of a yellow color, but the black stripes and spots on some species and the almost entire black of others rather leads to the inference that black is in this case a warning and not a protective color. Or, in other words, while the colors of some of our species might be supposed to be protective, their coloration appears to be so only so far as warning colors can be said to constitute protection. The color of *D. longicornis*, being as it is of a uniform green color, or at most but slightly tinged with yellow, would form a protection, provided it fed upon foliage of the same color—but it does not; and its green color only makes it the more conspicuous on the purple bloom of the thistle, or the yellow flowers of the *Solidago*. If *12-punctata*, *soror* or *tricincta* habitually fed upon a yellow background like, for instance, the rays of the flowers of *Helianthus*, and should puncture them with small holes that would at a short distance resemble small black spots, then these species might be supposed to gain protection from their coloration. But neither these or *longicornis* are seemingly in the least protected by their coloration, and their immunity from attacks of birds must be due to other influences. Bates, in his "Naturalist on the River Amazon," states that in the forests along the Amazons "the Eumolopidæ and Galerucidæ were much more numerous than the Chlamydes and Lamprosomas, although being also leaf eaters and having neither the disguised appearance of the one or the hard integuments of the other; but many of them secrete a foul liquor when handled, which may perhaps serve the same purpose of passive defence." It is here that without doubt we shall find the secret of the protection of species of *Diabrotica* against the attacks of birds. Perhaps the most convincing evidence on this point is to be found in a paper by Mr. Charles J. Gahan, in Trans. Ent. Soc. Lond. 1891, pp. 367-374, plate XVII, in which, under the title of "Mimetic resemblances between species of the Coleopterous genera *Lema* and *Diabrotica*" seventeen species of the former genus, inhabiting South and Central America and Mexico, shows a remarkably close resemblance to nearly an equal number of species of the latter genus inhabiting the same regions. In the colored plate which accompanies this paper illus-

trations are given of ten of these cases of mimetic resemblances, and it must be confessed that Mr. Gahan has made out an extremely strong point. But one of our North American species of *Diabrotica* is included in this list, *D. vittata*, which is given as the protector of *Lema nigrovittata*. I have strongly suspected this of our *Diabrotica* for several years, but the only case that appeared to me at all probable was that of our *Ceratomya caminea*, some of the collorial forms of which resemble *D. 12-punctata*. But Mr. Gahan in his list gives *C. arcuata* as being mimicked by *Lema crucifera*, in Cayenne, which if correct, as I am inclined to believe, would render any such relation impossible. Of our seventeen species and varieties of *Lema*, as included in Henshaw's list, I have compared ten with an equal number of our eighteen species of *Diabrotica*, but shall be obliged to confess that among our North American species of these genera there does not appear to be any mimetic resemblances whatever, at least so far as my comparisons have carried me.*

Mr. Gahan, with commendable candor, freely admits that fresh observations of the species of the genera *Lema* and *Diabrotica* in their living stage will have to be made before it can be definitely established that the resemblances between them are cases of true mimicry. When this has been done, whether we find similar relationships existing among our North American species or not, we shall have ample proof of the inedibility of the species of *Diabrotica* and thus solved the problem of their protection from attacks of birds, as indicated by the great number of examinations made of the food of many of the most common of our species.

In conclusion, it would seem as though Central America, Mexico and possibly southern Arizona, southern New Mexico, and perhaps also southern Texas, comprised the womb, as it were, within which our North American species of *Diabrotica* had been formed and from out of which they had issued. And may it not be possible for the careful student, located within these boundaries, to still witness in Prof. Cockerell's *incerta*, variety of *D. vittata*, LeConte's *tenella*, variety of *12-punctata*, Harold's *12-notata* or some of the variations of *atripennis*, the actual evolution of species? A study of this genus of beetles over the area indicated will certainly richly reward the student, and not unlikely bring to light some facts that will prove of immense value to the science of biology in general.

*This statement has since been verified by examinations of these genera as represented in the National Museum at Washington and the Philadelphia Academy of Science.

One point more and I am done. Without intending the least disrespect for that veteran worker, Dr. Horn, I wish to say that the distribution of species as usually indicated by him in his writings, and for which collectors are doubtless largely responsible, are almost valueless in studies of this sort, and I wish to emphasize in the strongest manner possible the point made by Mr. L. O. Howard, in his paper on the "Geographical distribution within the United States of certain insects injuring cultivated crops," where the plea was made for an *exact* record of the occurrence of a species—for exact localities, instead of sections of country or States.

FINAL NOTE ON THE PLATYPTERYGIDÆ.

By A. RADCLIFFE GROTE, A. M.

I refer to my paper on this family Can. Ent. XXVII, 133, and wish here briefly to draw attention to what seems to me the true position of our single American species referred to *Platypteryx*, according to Neumøgen and Dyar's arrangement, although I had supposed we had three: *siculifer*, *arcuata*, *genicula*. It may well be these names only apply to races or forms of a single species: *arcuata*. I take it for granted that my argument as to the proper name for the family cannot be gainsaid. Before any idea had been expressed in literature that the genus represented a family, Hübner had fixed the type of *Platypteryx* in the Tentamen and pluralized the name (Platyptericæ), using it for the group afterwards in the Verzeichniss (1818). Stephens adopted this name for the group in 1829, changing the termination to follow Swainson's rule (1827) for families, calling it Platyptericiidæ. In 1868 I corrected the writing of the word to Platypteryginæ, regarding the group as a subfamily of Bombyciidæ, following Packard. It should now be called Platypterygidæ, if we would respect the rules; it is correctly given in the Philadelphia Check List. No change in this title for the family seems permissible; the terms "Drepanulidæ" and "Drepanidæ" are simply synonyms and should be abated. For the type of Schrank's genus, with mixed contents, of 1802, is not yet indicated. The only certain generic type we have is *Platypteryx hamula* (*binaria*), and this is for Laspeyres' genus. Its designation by Hübner left at least three generic types still in Schrank's original genus, any one of which might be available for *Drepana*. The family type is fixed by Hübner, and the family name must be formed from the genus of this type. From a study of Speyer's excellent popular work it seems to me probable that the type of *Drepana* may be correctly held to be none